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ABSTRACT

Ecological research methodology can assist the educational technologist in both his practical decision making responsibilities and in his more formal pursuit of theoretical understandings. Critics of traditional methodologies maintain that the validity of educational inquiry, as well as the generation and verification of educational theories, can be improved by employing methods that deal more adequately with the subtlety and complexity of the natural world. The term ecological inquiry is clarified through a discussion of its conceptual parallels in other disciplines, its distinguishing characteristics, and its difficulties and disadvantages. Applications of ecological inquiry to instructional development are suggested. (Author/STS)

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ECOLOGICAL INQUIRY: EXPANDING THE DEFINITION

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ABSTRACT

The validity of educational inquiry has been much criticized by those who favor a more ecological approach to the investigation of complex problems. It is the position of these critics that the external and internal validity of educational inquiry as well as the generation and verification of educational theories can be improved by employing methods that deal more adequately with the subtlety and complexity of the natural world. The parallels of ecological inquiry that exist in the social sciences and in education are described and related. Characteristics of inquiry methods that tend to increase the ecological validity of investigation results are presented. Some of the major difficulties encountered in undertaking ecological inquiry are mentioned. Finally, applications of the methodology to the practice and knowledge generation functions of instructional development are suggested.

The paper takes the position that ecological methodology can assist the educational technologist in both his practical decision making responsibilities and in his more formal pursuit of theoretical understandings. The educational technologist is perhaps in a uniquely favorable position to utilize the methods of ecological inquiry, and its scope makes it a particularly useful methodology for him to master.

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ECOLOGICAL INQUIRY: EXPANDING THE DEFINITION

Sharon Shrock

The adjective ecological has moved beyond its biological denotation and found its way into the education literature. This term and several others with similar connotations have been borrowed to describe a lack of validity in educational inquiry, i.e. some critics argue that orthodox experimental design yields results that do not accurately reflect behaviors and cause/effect relations that exist in the "real world." This paper begins with a summary of the concerns that have led some writers to suggest the need for an ecological perspective among educationists -- a greater appreciation of the subtlety and complexity of the natural world we are trying to explain through educational inquiry. The term ecological inquiry is then clarified through a discussion of its conceptual parallels in disciplines other than educational research, and distinguishing characteristics often present in the approach are listed and described. Some common difficulties and disadvantages encountered in conducting ecological inquiry are presented. Finally, applications of ecological inquiry to instructional development are suggested.

THE CRITICISM THAT SUGGESTS AN ECOLOGICAL APPROACH

The criticisms of educational research that recommend an ecological approach are familiar ones. They will be discussed only briefly here because they have been presented extensively elsewhere. For purposes of summarizing them here, the criticisms may be categorized as follows: 1) external invalidity, 2) internal invalidity, and 3) inadequate generation and verification of theory.

The most frequently heard criticism of current educational

inquiry is that it produces results with limited external validity, i.e. the findings cannot be generalized "across times, settings, and persons." (Cook and Campbell, 1976) Some external validity problems are nearly unavoidable because they are a consequence of efforts to control in the experimental sense; external validity is sacrificed to maximize internal validity. Yet proponents of an ecological approach to educational inquiry would argue that the balance in this validity "trade-off" has tipped precariously in favor of experimental control and internal validity. The common lack of generalizability of findings across all three dimensions -- persons (population validity), times and settings (ecological validity) -- has been noted in the education research literature.

Bracht and Glass (1968) and Kempthorne (1961) summarize the population validity problem as composed of two required "jumps" in generalization: 1) the investigator must generalize from his experimental sample to the accessible population from which his sample was drawn and 2) he must generalize from the accessible population to the target population, the entire group of persons about whom he is trying to learn. Validity of the first "jump" is ensured by random selection of the sample from the accessible population. The second "jump" from the accessible to the target population is made with relatively less confidence. As Bracht and Glass emphasize, "the only basis for this inference is a thorough knowledge of the characteristics of both populations and how these characteristics interact with the experimental treatment."

Kempthorne's (1961) note that target populations do not remain the same over the years introduces time as another dimension across

which findings may be invalid. As Cronbach (1975) has stated "Generalizations decay. At one time a conclusion describes the existing situation well, at a later time it accounts for rather little variance, and ultimately it is valid only as history ... The positivistic strategy of fixing conditions in order to reach strong generalizations fits with the concept that processes are steady and can be fragmented into nearly independent systems. Psychologists toward the physiological end of our investigative range probably can live with that as their principal strategy. Those of us toward the social end of the range cannot." Thus Cronbach argues for interpretation of existing reality as opposed to fixed generalization about it.

Perhaps the form of external validity most wanting in current educational inquiry is situational or ecological validity. The artificial and limited environments in which most of educational research has been conducted have been increasingly under attack. The extreme in externally invalid research is described by Pereboom (1971) who feels that some behavioral outcomes under investigation are in fact merely a product of the method or apparatus used in the experiment itself, i.e. experimenters are drawing conclusions and building theories on the basis of behavior that in fact does not occur in the non-experimental, "real world." Brunswik (1956) whose concern over the inadequate sampling of situations in psychological research prompted him to argue for an "ecological N" stated that "experiments in the biological and social sciences ... often ... do demonstrate a mere possibility." A less extreme criticism of ecological validity in educational

research is provided by Bracht and Glass (1968) who list and explore a number of common yet potentially devastating threats to situational validity such as Hawthorne effect, experimenter effect, pre- and post-test sensitization and others.

Although it is external invalidity that seems to generate most of the current criticism of educational inquiry, internal validity has not been ignored by those who advocate an ecological approach. Criticism of internal validity is less severe because maximization of internal validity is the raison d' être of orthodox experimental research design. To the extent that educational research conforms to the ideal of classical design, the internal validity of its results will be beyond reproach. However, a great deal of educational research now uses so called quasi-experimental designs, i.e. designs in which respondents are assigned to experimental treatments in nonrandom fashion. (Cook and Campbell, 1976) As Cook and Campbell point out, "the major difference between true experiments and quasi-experiments has to do with internal validity." While randomization eliminates most threats to internal validity in true experiments, in quasi-experiments protection must be found by other means. Quoting Cook and Campbell again, "instead of relying on randomization to rule out most internal validity threats, the [quasi-experimental] investigator has to make [all of the threats] explicit and then rule them out one by one." Therefore, internal validity is increased to the extent that the investigator is aware of all plausible, alternative explanations of his data besides the causal relationship he has hypothesized.

A third realm of the inquiry process that has been criticized by those who favor an ecological perspective is the generation and

verification of theory. Many of the criticisms that Glaser and Strauss (1967) have made of the generation of sociological theory can be applied to educational theorizing as well. Their complaint is the poor "fit" between theory generated by logical deduction from a priori assumptions and the real situations to which the theory is applied. In their words, "Theory must fit the situation being researched and work when put into use. By 'fit' we mean that the categories must be readily (not forcibly) applicable to and indicated by the data under study; by 'work' we mean that they must be meaningfully relevant to and be able to explain the behavior under study." Their recommendation is that theory be formulated directly from observation of the real world. Pereboom (1971) recommends a similar methodological orientation when verifying an existing theory. According to Pereboom "the failure to confirm an hypothesis may mean that the hypothesis is wrong or that some confounded variable was present, some peculiar values were selected for those conditions held constant, or that some unrecorded aspect of the behavior is responsible for the negative results. The tendency to cling to well known or long-standing theories and to publish only results supportive of these theories causes the research literature to distort the true nature of things and allows the ultimate confirmation somewhere of almost any hypothesis." Quoting Pereboom again, "the upshot of the problem is that theories rarely die in psychology, they just accumulate." Furthermore, Dubin (1976) makes an ecological suggestion in the interest of "improving a theory," an activity that combines aspects of both generation and verification. "The essential operation involved in a research approach oriented toward improving a theory

is to give particular attention and prominence to deviant cases and non-fitting data. None of the advantages of the theory proving orientation are lost."

TERMS THAT NAME AN ECOLOGICAL APPROACH

The problems discussed in the previous section are not ones unique to educational inquiry; other disciplines that seek to explain and predict complex phenomena that cannot legitimately be "broken up ... into a temporal chain of events, all connected by determinate 'causal' relations" (Rapoport and Horwath, 1968) have faced similar difficulties. Therefore, it is not surprising that the perspective heretofore referred to as "ecological" has emerged independently within a number of disciplines outside education and within various interest groups inside the larger field of education. The following terms are ones that often appear in the literature in close association with ecological inquiry. The attempt here is to differentiate among them and thus encourage precision in their use. Space does not allow extensive commentary on each of these terms. The reader is referred to the references provided for a fuller treatment of their origins and applications.

Ethnography - This term denotes descriptive anthropology. Though it can involve hypothesis formation and verification, its connotation -- especially when applied in education -- emphasizes the accurate description of complex social behavior as observed by researchers in situ.

Grounded Theory - This term originates in sociology and refers to explanation of human behavior that is generated directly from the "data systematically obtained from social research" as opposed to theory formulated by logical deduction from a priori assumptions.

(Glaser and Strauss, 1967) Quantitative as well as qualitative data can be utilized, but since much quantitative data necessarily reflects categories of predetermined relevance, qualitative methods are generally used to collect the data from which theory emerges. The methods of grounded theory such as constant comparative analysis and theoretical sampling described by Glaser and Strauss are transferable not only to educational theorizing but to other areas of inquiry in education that benefit from an ecological perspective such as evaluation. (Smith and Pohland, 1969) While the "grounded" approach is generally valued as a means of generating hypotheses and theory, Glaser and Strauss maintain that the resulting explanation is often so thoroughly functional when applied that it requires no further verification. Briefly, the hallmarks of grounded theorizing are 1) the absence of a priori assumptions or hypotheses 2) the simultaneous collection and analysis of data which allows preliminary analysis to dictate subsequent data collection, and 3) the priority granted the generation of a theory (or explanation) from data as opposed to the collection of data in the interest of verifying an existing theory or explanation.

Qualitative Research - This term is applied throughout the social sciences to designate research based on data that is not quantified. Qualitative research connotes data collection in the field as opposed to artificial settings and the use of observation and interviewing techniques. (Filstead, 1970) Because of its capacity to handle "real world" complexity, qualitative research methodology is often employed by investigators advocating an ecological perspective. However, observation and interviewing can result in quantified data, and the use of qualitative research methodology

does not guarantee ecological inquiry.

Representative and Quasi-Representative Research Design - Representative research design is associated with Egon Brunswik's pioneering efforts to increase the external validity of reserach in perceptual psychology. Brunswik's major point was that situational variables need to be controlled by research design and studied by experimentalists just as population variables are controlled and studied. His suggested means of controlling situational variables are essentially the same as long accepted means of controlling for subject differences. For example, Brunswik advocated sampling situations from a well defined universe of conditions so that situational variables present during an experiment are "representative" of those variables present in the situations to which the experimental results will be generalized. In Brunswik's words, "Proper sampling of situations and problems may in the end be more important than proper sampling of subjects, considering the fact that individuals are probably on the whole much more alike than are situations among one another." Furthermore, a major characteristic of Brunswikian thought is the application to situational variables of the analytical methods customarily employed in the study of individual differences. Again quoting Brunswik, "[representative research design is] object-centered rather than subject-centered in the sense that there are no 'persons' in the plural at all but only a sample of external situations responded to, on principle, by one subject." Brunswik's work might be best characterized, then, as an unorthodox application of established methods of investigation rather than advocacy of more natural inquiry. Snow (1974) has adapted some

of Brunswik's notions for educational research and called the resulting designs "quasi-representative." However, for purposes of conceptual distinction, it should be noted that Snow substitutes thorough description of both treatment and population characteristics in place of Brunswik's random sampling from a universe of situations; Brunswik thus remains closer to traditional statistical experimental design.

Ecological Psychology - Ecological psychology is distinguished from orthodox experimental psychology by the psychologist's role in generating the data. Barker (1965) maintains that psychologists adopt one of two roles in a research situation: the role of "transducer" between phenomena and data, i.e. a translator of phenomena into data in accordance with some coding system or the role of "operator", i.e. one who dominates the experimental situation by "regulating input, and/or influencing interior conditions, and/or constraining output" as well as serving as translator of the phenomena into data in the transducer sense. Ecological psychology seeks to understand the effect of environment upon behavior by placing the investigator in the role of a "transducer" confronting undisturbed behavior and environment and generating analytical data from them. Barker, however, expects substantial reduction of reality by the psychologist-transducer; the data resulting from ecological psychology is encoded (if not quantified) rather than narrative. Furthermore, in contrast with grounded theory, the methods of ecological psychology are not considered a means of generating hypotheses for subsequent verification by psychologists acting as "operators." In Barker's words, "What [transducer] methods do, [operator] methods cannot do at all:

[operator] methods cannot signal behavior and its conditions unaltered by the system that generates the data."

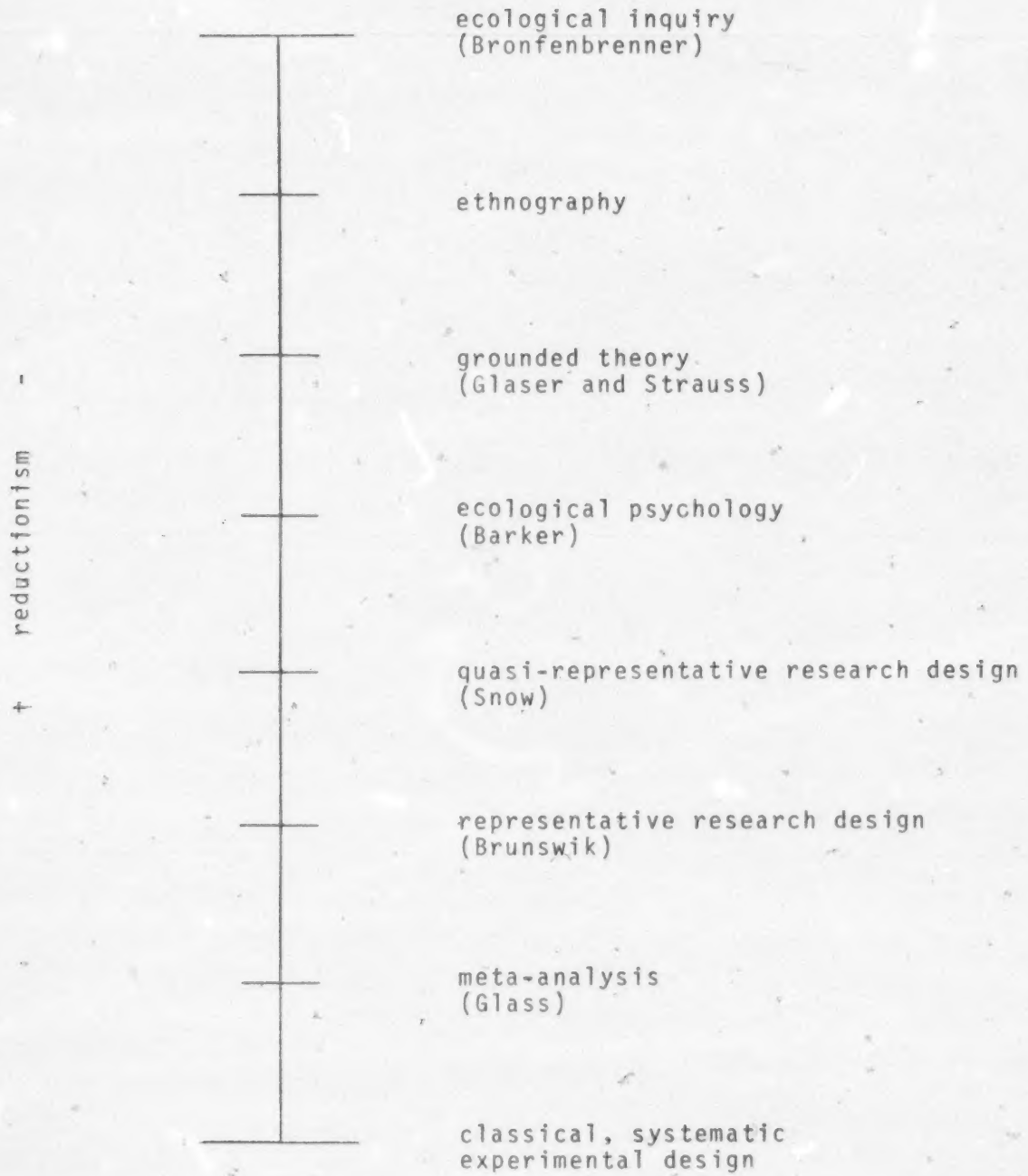
Environmental Psychology - Like ecological psychology, this emerging field within psychology proper focuses upon situational determinates of behavior. However, environmental psychology does not emphasize the micro-interaction between behavior and environment that so characterizes ecological psychology. Environmental psychology appears most interested in exploring the effects of massive environmental variables such as overcrowding, temperature, pollution and the like. Furthermore, beyond an unavoidable attention to the "real world," the methodology of environmental psychology does not appear distinct from traditional experimental psychology as do the techniques employed by ecological psychologists.

Meta-analysis - In the words of Glass (1976), meta-analysis refers to "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings." Although the term is relatively new and, therefore, has not yet begun to appear in discussions of ecological perspective, the method's utility in pursuing ecological understanding will surely not be missed. Because it synthesizes the results of many individual studies, the results of meta-analysis tend to be based on a wider "sampling" of situational conditions. A variation of the meta-analytic approach may be as close as current investigators can come to employing Brunswik's notion of sampling from a universe of situations.

Ecological Research - This term has no single definition; each of the terms above denotes methods or disciplines that, when employed, increase the ecological understanding of the phenomena

under study. Perhaps the criteria that describe the ideal ecologically valid research are those written by Bronfenbrenner (1976). Bronfenbrenner's criteria, if met, would require research that thoroughly explores the properties of the immediate situation, the effects of behavior upon setting as well as of setting upon behavior, and the effects of more remote settings -- even institutions and ideologies -- upon behavior. As one means of making a summary statement concerning the terms listed above, one might place them on an ordinal continuum as in Figure 1. Any continuum that could relate such disparate terms must necessarily be abstract; the one below ranks the terms according to the degree to which their methodologies require reduction of real world complexity. The continuum is intended to be descriptive rather than judgmental; the best approach is always defined by the nature of the problem under study. (See Figure 1 below.)

Figure 1


+ reductionism -
ecological inquiry
(Bronfenbrenner)
ethnography
grounded theory
(Glaser and Strauss)
ecological psychology
(Barker)
quasi-representative research design
(Snow)
representative research design
(Brunswik)
meta-analysis
(Glass)
classical, systematic
experimental design

CHARACTERISTICS OF ECOLOGICAL INQUIRY

As previously stated, there is no single accepted definition of ecological inquiry indicated by the word's use in the social science literature. Perhaps there should never be. The word "ecological" currently serves a useful function; while it is not possible to say "This is ecological inquiry. This is not," it is possible to say that one investigation is more ecological than another or that a given research design is more sensitive to ecological validity than another. In other words, as suggested by the continuum in the previous section, the meaning of the word is relative rather than indicative of a discrete category of inquiry. Therefore, just as there are a number of terms that indicate a concern with ecological knowing, there are a number of characteristics which when present in an investigation tend to augment its potential to yield ecological understanding. However, the presence of one or all of these characteristics does not define ecological inquiry; they are discussed here because they help to operationalize this otherwise abstract term.

Absence of a priori assumptions - Much of the inquiry that seeks ecological understanding is characterized by a relative absence of a priori hypotheses and decisions regarding the importance of variables and outcomes. Rather, the investigator enters the study with only tentative notions about what might be important, forces himself to be open to all aspects of the phenomena before him, and then allows the relevant outcomes and most powerfully explanatory variables to emerge as the study progresses. Another perhaps less radical way of viewing this approach to inquiry is as Brunswik (1956) called it "a successive omission" as opposed to "a successive

accumulation" of factors. The investigator deals initially with an undisturbed phenomena having as the goal of his inquiry the elimination of irrelevant factors and, ultimately, a parsimonious explanation of causes and effects. Such an ultimate establishment of an explanation might require additional systematic experimentation of the classical type.

Theoretical Sampling - this term is defined by Glaser and Strauss (1967) as "the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decided what data to collect next and where to find them, in order to develop his theory as it emerges." As a characteristic of ecological inquiry it is largely a consequence of the absence of a priori assumptions previously mentioned. Smith and Pohland (1969) provide a fine description of the interactive nature of data collection and decisions about further data collection that prevails when an investigator and the course of his study remain open to the complexity of the phenomena he is monitoring. In their discussion of their application of theoretical sampling in the evaluation of computer assisted instruction, these authors clarify the technique by describing how data is collected for the purpose of building conceptual categories after an investigation has begun.

Comparative Analysis of Groups - Theoretical sampling of data will often suggest comparisons among groups of various degrees of similarity. If the inquiry is directed toward hypothesis or theory generation, the comparisons help define the variables or theoretical elements and their relationships. If the inquiry is verification oriented, systematic comparison across groups

strengthens the population and ecological validity of the findings.

Real World Settings - As suggested by Snow (1974) moving research out of laboratories and other artificial environments and into the natural world is an essential means of establishing the ecological validity of the results. However, the replication of an experiment across natural settings as recommended by Bronfenbrenner (1956) is a frequently ignored step even among those ecologically sensitive enough to value natural experiments.

Observation and Description - Because of its focus upon complex phenomena, much of the data of ecological inquiry can only be had through observation; test scores, questionnaire responses, and GSR records alone will never suffice. As Cronbach (1975) noted, "There are more things in heaven and earth than are dreamt of in our hypotheses, and our observations should be open to them." The companion characteristic of description occurs as one means of preserving the complexity observed. Descriptive records are particularly valued among the ecologically inclined since they preserve the complexity of phenomena out of which additional hypotheses or conceptual categories may be drawn. However, it should be noted that observation can result in encoded data as well; descriptive narration is only one means of summarizing the complex.

Qualitative Data - As just noted, ecological inquiry often generates qualitative data as a means of coping with complexity. However, this statement should not denigrate the use of quantitative data in the pursuit of ecological understanding. In their book on discovering grounded theory Glaser and Strauss (1967) illustrate how quantitative data can serve as the phenomena from which theory

is generated. However, quantitative analysis in ecological inquiry is often correlational because of correlation's ability to incorporate the information contained throughout the entire range of a continuous variable . In any case, the statistical analysis employed must generally be one capable of handling the effects of several variables simultaneously. The more variables a technique can accomodate, the greater its utility in the pursuit of explaining the interaction that characterizes ecology.

Multiple Data Sources - Ecological inquiry tends to seek out more data sources than traditional experimental design. This characteristic is a function both of the methodology's attempt to explore all aspects of a situation and of its attempt to establish the reliability of its data. An ecological investigator may value written documents as well as the "responses" of "subjects," and he may have to include a co-investigator in his design in order to cross check the accuracy of observation data.

Value Accorded Deviant Results - Ecological inquiry is alert to deviant results and unanticipated outcomes. Deviance is worthy of notice and preservation because, as Cronbach (1975) suggested, inconsistency may not be due to statistical sampling error or totally incorrect hypotheses, but to a higher order interaction than anticipated. Deviance becomes the clue to improving the theory; the unanticipated outcome may be the one of greatest consequence.

Value Accorded Subjects' Impressions - Data often of interest to ecological investigators are the observed individual reactions of subjects to a treatment or subjects' self reported impressions of the phenomena under study. In Snow's (1974) words, "unfortunately,

the traditional emphasis on systematic factorial design has, perhaps unwittingly, fostered concentration on the boundaries of an experiment to the neglect of events occurring within the cells between pretest and posttest." He suggests "intraexperiment observation" as a means of collecting this micro-ethnographic data. Quoting Snow again, "Introspective and retrospective reports are usually possible. And there is always that first and perhaps most subtle and sensitive scientific method of all, informed naturalistic observation on the Darwinian model."

THE DIFFICULTIES OF UNDERTAKING ECOLOGICAL INQUIRY

Ecological inquiry, like systematic experimental design, has its critics. While a discussion of its deficiencies as a means to knowledge will not be presented here, some of the practical difficulties involved in its conduct can be briefly considered.

Time Consumption - Adding the ecological perspective to one's research design is often costly. The time required to consider multiple data sources, conduct extensive observations or interviews, replicate an experiment across settings, or redefine (let alone create) one's conceptual categories is far beyond that available to the uncommitted.

Limited Access to Real-Life Situations - Much of the natural world that we would like to submit to ecological inquiry is closed to outsiders either bureaucratically or because its delicate balance does not permit intruders. Gaining "official" access to the phenomena of interest may be only the first in a series of sensitive hurdles.

Skill Requirements - The skills required to conduct ecological inquiry are often omitted from the training received by classical experimentalists. Some of the fundamental skills required for effective natural inquiry are described by Wolf (1977) as follows: "Some of the more basic skills include listening, question asking, flexibility, coping with ambiguity and resiliency. Other skills more difficult to describe involve the ability to think spontaneously, to analyze and synthesize data *in situ* so as to eliminate or illuminate inferences, to avoid moral pigeon holing, to understand self-prejudices, to take useful field notes and accurately summarize information, to learn the value of comprehensive and frequent debriefing sessions, to become facile in conversing with people, and to learn how to move through natural settings with ease."

Rejection by Traditional Experimentalists - Classical experimentalists and even quasi-experimentalists may dismiss some or even most aspects of ecological methodology as violations of cherished safeguards of internal validity. Some of those who will hold this opinion will be sitting on the editorial boards of major educational research journals. The payoff from much ecological inquiry comes in the form of increased understanding rather than increased publication.

Perhaps in light of the above named difficulties the most demanding requirement of conducting ecological inquiry is sincere commitment to discovery of truth. Some components of ecological methodology *do* require lowering some of the more obvious barriers to investigator bias erected by orthodox research design. Where this is the case, the investigator's integrity and awareness of

self-bias are the safeguards, as they are ultimately in all inquiry. In this regard, the ecological perspective is perhaps now viable only because of the long history of rigorous standards that have been applied to experimental design. It is as if we needed a number of years to convince ourselves of our commitment to dealing honestly with the real world about us before going out to look at it. The methods of ecological inquiry invite us to do just that.

THE APPLICATION OF ECOLOGICAL INQUIRY TO INSTRUCTIONAL DEVELOPMENT

Throughout most of this paper, the term ecological has been modifying the word inquiry. Inquiry was the preferred noun because, as Schwen (in press) has noted, it identifies a single function that "integrates" several different professional roles. One could legitimately speak of ecological methodology applied to evaluation and research as well as to instructional development. This concluding section of the paper will focus upon the latter application.

One way in which to relate ecological methodology to instructional development is to identify questions typically asked by developers that could perhaps be most effectively answered by application of ecologically oriented techniques. Developers work in the real world and so must answer practical questions in the interest of solving specific instructional problems. At the same time, they share the educational researcher's interest in the generation of educational theory and generalizable knowledge. The first three of the following questions are ones that would occur in the day to day application of the development process to a real world problem. The fourth, however, suggests the utility of ecological inquiry in the more disciplined quest for knowledge

about educational technology.

What are the client's needs?

Needs assessment is an undertaking that benefits from the broad perspective characteristic of ecological approaches. As most experienced developers know, clients are often unable to articulate their needs with any degree of precision. The interviewing and listening skills of the developer are often critical in obtaining an accurate picture of what the client perceives his needs to be. Furthermore, and sometimes more importantly, a developer with an ecological perspective might consider the client as only one of many possible sources of data that could be collected in the determination of needs. Scriven (Salasin, 1974) actively warns against uncritical acceptance of a client's statement of goals; he recommends direct determination of needs via exploration of the instructional situation and the students -- exploration untainted by a priori assumptions about what needs to be done.

What are the resources and constraints affecting the solution to an instructional problem?

Most developers would agree that the effective obstacles to solving an instructional problem are frequently not immediately apparent. Sometimes there are political problems that even a relatively open client would hesitate to mention. Identification of gaps in content expertise and evidence of past failures, for examples, may be critical to improving instruction, but may require casting a wider "investigative net" (Cronbach, 1975) than merely discussing "problems" with the client. Observation of ongoing classes -- approached without any beforehand hypotheses -- has proved to be a very worthwhile time investment before tentative

solutions are even suggested. Though perhaps typically less obscure, positive factors that can be exploited by developers in the interest of solving instructional problems can be uncovered by the less restrictive data gathering techniques.

What are the outcomes of a treatment?

The methods of ecological inquiry probably have their greatest practical utility when applied at those stages of development usually termed evaluation. Awareness of all outcomes of a given treatment -- especially unexpected ones -- is essential to the proper revision of instruction. If too narrowly conceived, our outcome assessment may tell us clearly that something is wrong, but leave us guessing at the means of correcting the problem.

What generalizable knowledge toward a theory of instruction can be had as a result of instructional development?

As Schwen (in press) has noted, instructional developers are much concerned with increasing theoretical understanding and extending the cumulative knowledge available to the profession, even though they are more "constrained" by the demands of real-world application than most educational researchers. Because of their 'middle ground' stance between strictly theoretical and practical concerns, instructional developers are perhaps in a uniquely favorable position from which to engage in ecological inquiry. The developer's access to real-life experimental situations is greater than that of most researchers. Listening and observation skills should be sharpened in developers by their typically extensive contact with clients and content experts. Furthermore, as Schwen points out, generalizability is an important criterion for evaluating inquiry in educational technology.

Maximization of external validity is a characteristic of ecological methodology and would seem to recommend its application in the development process; we could perhaps augment our contributions to the knowledge base of educational technology by intentionally incorporating ecological research methodology into the conduct of instructional development.

In conclusion, it would seem that a wide range of techniques for increasing the ecological validity of educational inquiry exist. The goal of ecological understanding is a lofty one; implementation of the methodologies designed to provide it are fraught with difficulties, not the least of which is the acquiring of skills, perspectives, and values somewhat outside the mainstream of educational inquiry. Those of us who choose to seek such understanding face a challenge from the scientific tradition to apply the methodology with integrity and a sense of discipline. If we do so, ecological methodologies can vastly increase the investigator's options when choosing an appropriate strategy for inquiry and add expanded meaning to Herbert Blumer's challenge to all inquirers, "Respect the nature of the empirical world and organize a methodological stance to reflect that respect."

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